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CONTENTS.

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TRANSACTIONS OF THE SOCIETY FOR BRITISH ENTOMOLOGY

VOL. 14 APRIL 1961 PART VI

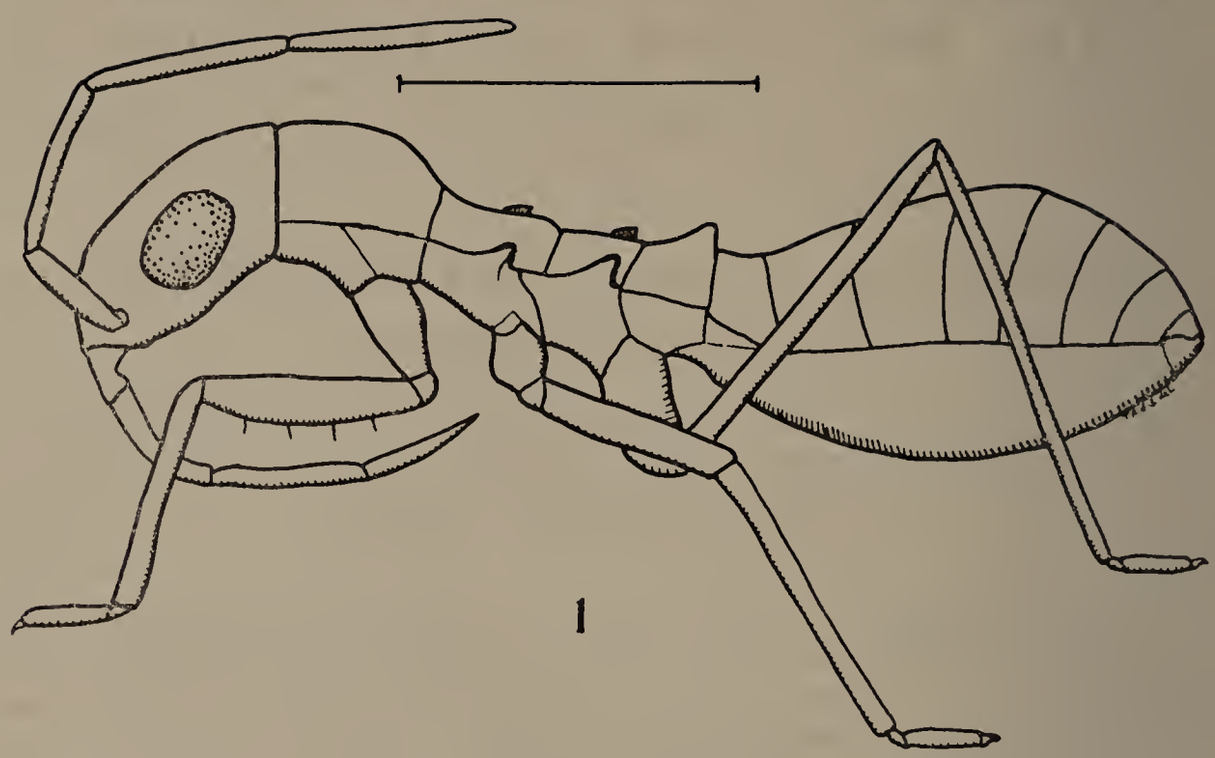
The Immature Stages of the Commoner British Nabidae (Heteroptera)

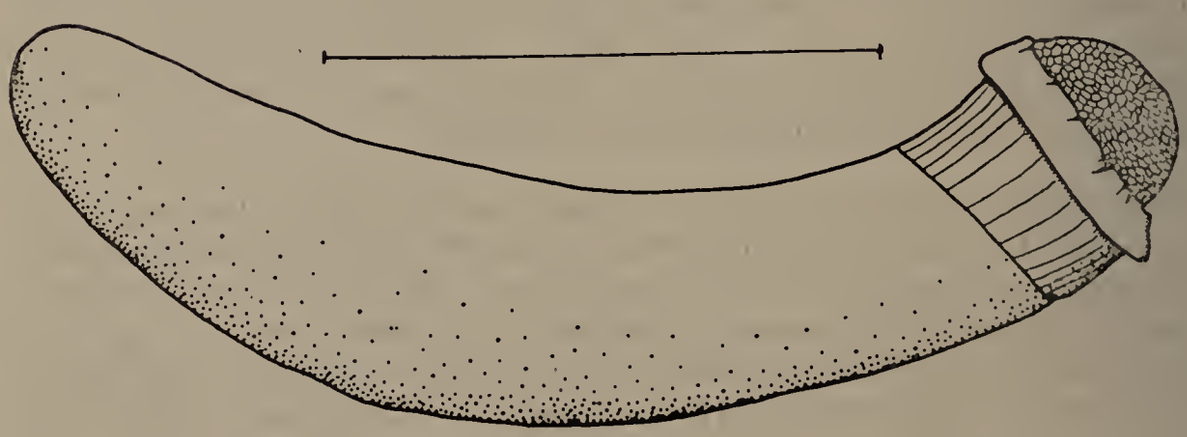
By T. R. E. Southwood, Ph.D., A.R.C.S., and
D. W. Fewkes, Ph.D., D.I.C.
(Imperial College, London)

The Nabidae or damsel bugs are moderately large predatory Heteroptera, recognised by their strongly curved, four jointed rostra (Fig. 1). There are but 13 species found in Britain and six of these are common in grassland, often being the most abundant predators taken by sweeping in such habitats. None the less, almost the only descriptions of the immature stages are those of Butler (1923) who, in many cases, was not able to be precise as to the instar he was describing, and in one case it seems his specimen was referred to the wrong species. It is hoped that the present paper, although not covering all the British species, will enable the ecologist or general entomologist to identify these common insects. Descriptions and keys are given for the egg and larval stages of the six more abundant grassland species, the arboreal *Himacerus apterus* Fab. and the heathland *Nabis ericetorum* Scholtz. The later stages of the scarcer *Stalia boops* Sch. and the local *Dolichonabis lineatus* (Dahlbom) are also described. Brief notes are given on the biology for the sake of completeness; more information is given by Southwood and Leston (1959). In Britain there is but one generation a year in all the species described. The species not covered are the newly recognised and local *Nabis pseudoferus* Remane (Southwood and Remane, 1956), and the very rare *Nabis brevis* Scholtz and *Prostemma guttula* Fab., both of which have not been collected in Britain in the last twenty years at least.

The whitish eggs of the Nabidae can be distinguished from those of pentatomomorphan Heteroptera by their cimicomorphan characters, i.e. the presence of an egg cap or operculum and the absence of micropylar canals (Southwood, 1956); their large size and the clearly visible operculum will separate them from Mirid eggs. Nabid eggs differ from those of Cimicidae (including Anthocorids) and Tingidae in their larger size and long micropylar region.

The larvae can be separated from those of other families by Leston & Scudder's (1956) key; but the long, curved rostrum, the slightly raptorial forelegs and the somewhat elongate shape usually enables them to be recognised at once.





Figs. 1-3.—*Himacerus mirmicoides* second instar larva, lateral view. 2, *Nabis rugosus* egg. 3, *N. flavomarginatus* egg. (Scale 1 mm.)

The nomenclature used in this paper follows that of Southwood & Leston (1959).

Descriptions of Immature Stages

The diagnostic measurements of antennal length are given in Table 1. All identifications should be checked against these. The values for total length of the larval instars (front of labrum to tip of abdomen) are only approximate and vary a great deal: in life depending on whether the larva has fed or not, in preserved material on the method of preservation. All descriptions refer to the dorsal aspect of the larvae unless otherwise stated.

Nabis flavomarginatus Scholtz.

Ovarian eggs and some larvae are described by Butler (1923): we are of the opinion, however, that one of his descriptions refers to larvae of *Stalia major* (q.v.).

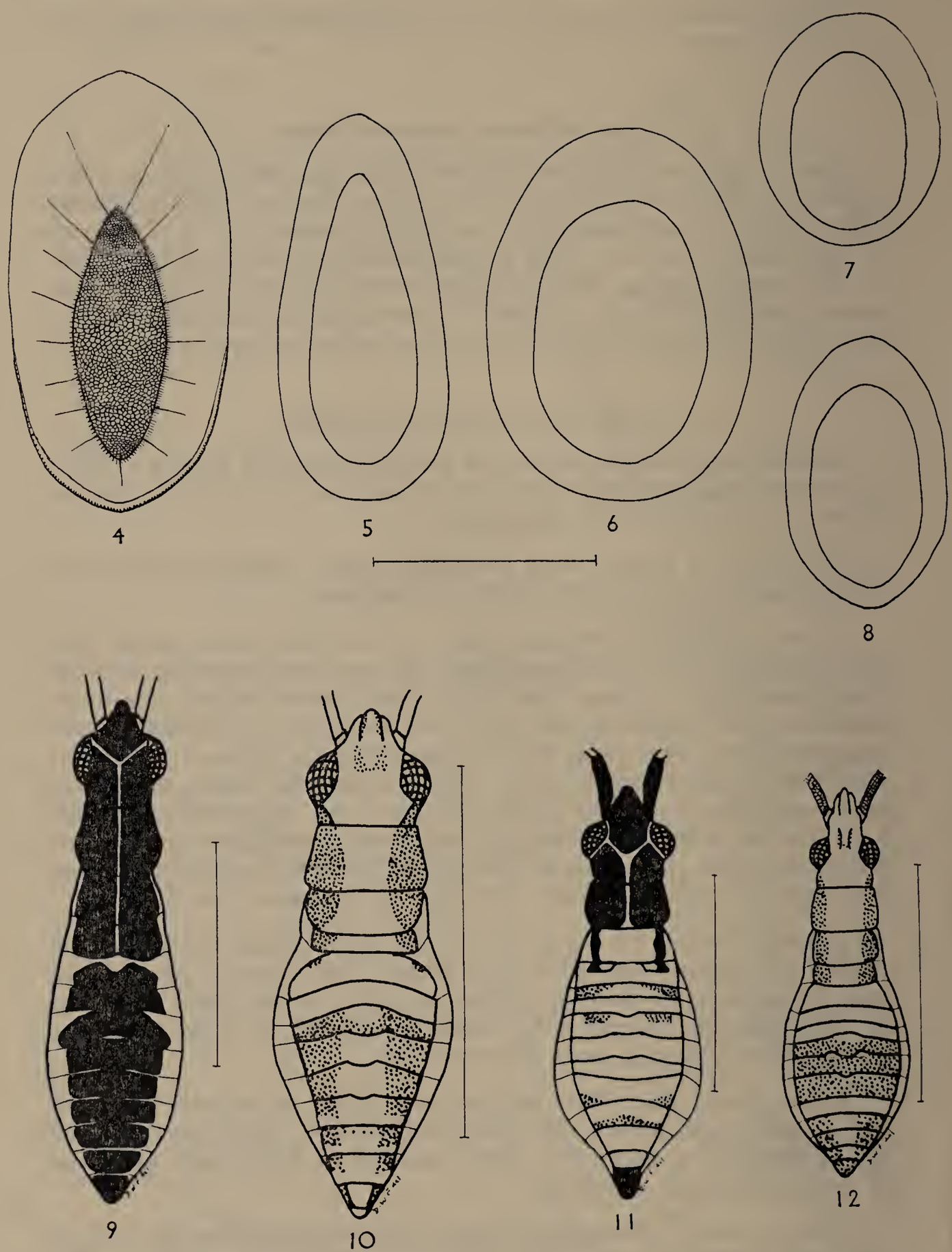
Egg (fig. 3): 2 mm. long, 0·4 mm. broad; elongate and curved with strongly convex pale brown operculum.

Larvae. First instar (fig. 16): 1·7-2·0 mm. long; head pale yellowish with dark V-shaped mark on vertex, extending forward along margins of clypeus and with dark areas behind the eyes; antennae pale; thorax pale with two longitudinal brown stripes, margins pale; legs pale with apices of tarsi brown; abdomen, segments 1 and 2 largely pale, with two lateral brown areas (the extent of these is subject to much individual variation), segments 3 to 9 with wide brown lateral stripes and connexivum (lateral foliaceous area of abdomen) pale, dark central markings anterior to dorsal abdominal glands' openings on segments 3 to 5.

Second instar: 2·8-3·2 mm. long; as first instar but with dark stripes on thorax and abdomen wider; thin brown central line may be present on thorax; abdomen with central dark markings on all segments except 6-8, nearly confluent so that abdomen is largely brown with pale connexivum.

Third instar (fig. 17): 3·6-3·8 mm. long; as second but with legs spotted with brown and dark markings on body more distinct (as in figure 17); there is a large amount of individual variation in amount of dark colouring.

Fourth instar: 4·8-5·4 mm. long; amount and intensity of dark colouration varies considerably; head and thorax as third instar but pale areas much reduced, sometimes almost absent; abdomen largely dark with two longitudinal pale areas on either side of the mid line on segments 3-8, segment 9 pale centrally; in dark specimens this is reduced to two pale spots at the posterior of segments 3-5 and at the anterior of segments 7 and 8; connexivum broadly pale.



Figs. 4-8.—Operculum and rim of chorion of egg viewed from above. 4, *Dolichonabis limbatus*. 5, *Stalia major*. 6, *S. boops*. 7, *Nabis rugosus*. 8, *N. ericetorum*. Figs. 9-12, first instar larvae. 9, *S. major*. 10, *N. ferus*. 11, *N. rugosus*. 12, *N. ericetorum*. (Scale, eggs 0·25 mm., larvae 1·0 mm.)

Fifth instar: 6·0-6·5 mm. long; as fourth but even darker; head still pale with two brown lines on either side of clypeus and V-shaped on vertex (base of V very broad in dark individuals); thorax and abdomen dark brown-black with lateral margins, connexivum and areas on either side of the mid line pale.

Biology

Common in grasslands, especially damp meadows or old rough fields, this species overwinters as eggs which, as in all grassland nabids, are laid in stems of grasses and various plants such as Hard Heads (*Centaurea nigra*). The eggs hatch in the first three weeks of May and the first adults of the new generation appear in late June, earlier than those of our other nabids. Larvae can be found in the field until September.

Nabis ferus L.

The egg has been described by Ekblom (1926) and four larval instars by Osborn (1918). There seems no doubt that Osborn's missing instar is the first, not the fourth as suggested by Butler (1923), and therefore the terminology of the stages described by Butler (1923) is in doubt.

Egg: 1·3 mm. long; 0·25 mm. broad; elongated, slightly upcurved just below egg cap, which is greyish-white and almost circular.

Larvae. First instar (fig. 10): 1·5 mm. long; generally very pale; head pale with sides of clypeus and V-shaped mark on vertex brown; antennae pale yellow; thorax pale with light brown lateral stripes; legs pale yellow; abdomen pale with light brown lateral stripes on dorsum of segments 2-8; connexivum pale.

Second instar: 2·5 mm. long; as first.

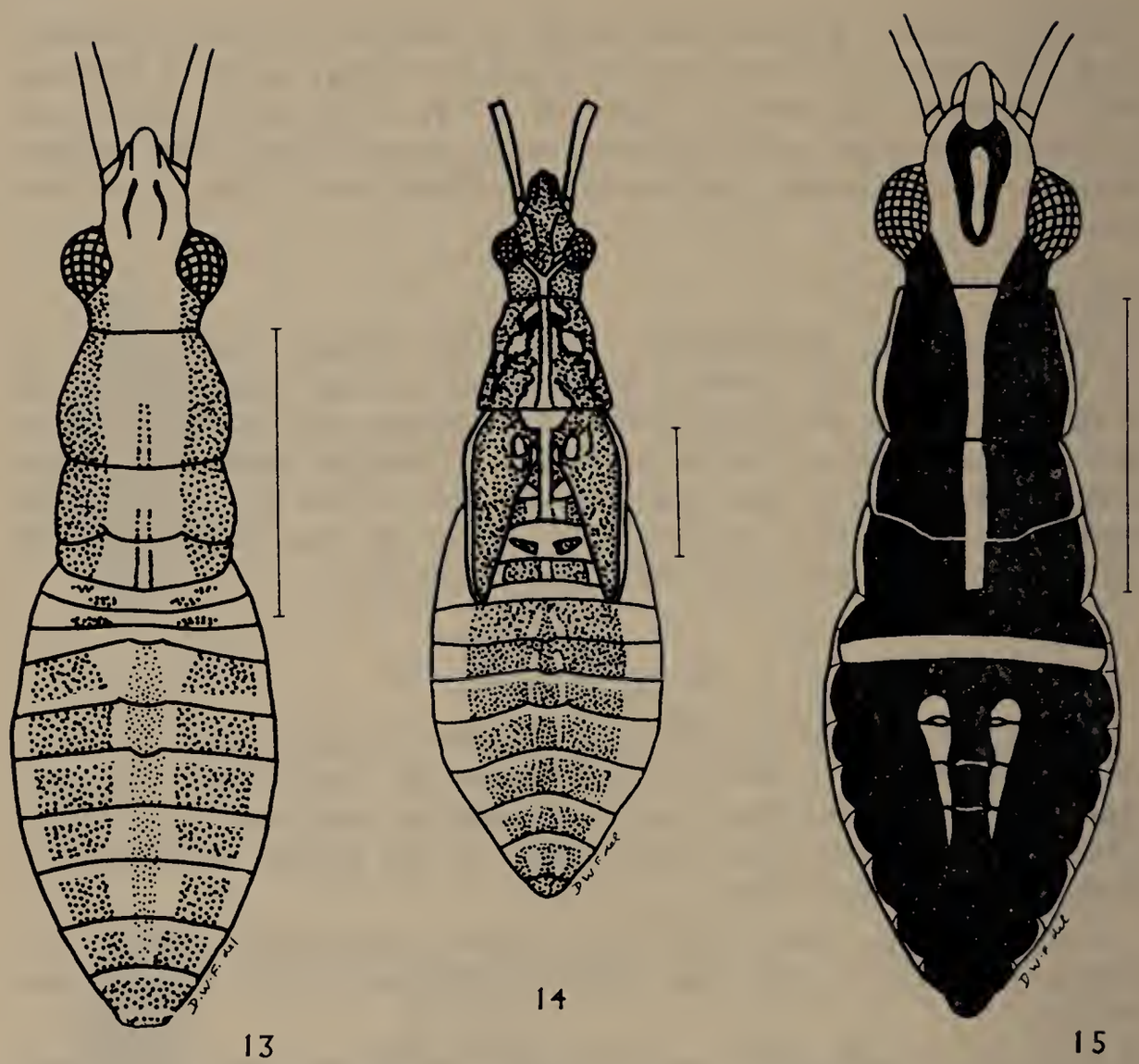
Third instar: 3·0-3·5 mm. long; as second, but brown markings darker.

Fourth instar: 4·0-4·9 mm. long; as third, but with pale areas in the lateral brown stripes of thorax and abdomen and thin central brown line on abdomen.

Fifth instar (fig. 18): 5·0-5·4 mm. long; as fourth instar.

Biology

This nabid is nearly always present in almost any sort of grassland, but it is seldom, if ever, as abundant as many of the other species e.g. (*N. flavomarginatus, N. rugosus, S. major*). It is the only common British *Nabis* that is always fully winged, light and suction trap data (Southwood, 1960) show that it flies frequently. Perhaps because of this habit it is the nabid most commonly found in corn-fields and other temporary grasslands. The adults overwinter and the eggs are laid in late May and early June.



Figs. 13-15.—Larvae. 13, *Nabis ericetorum* third instar. 14, *N. ericetorum* fifth instar. 15, *S. major* second instar. (Scale 1 mm.)

Nabis rugosus L.

Butler (1923) describes some ovarian eggs and the last instar larvae.

Egg (figs. 2 and 7): 1·3 mm. long; 0·32 mm. broad; elongated, slightly upcurved towards the egg cap which is whitish-grey and slightly elliptical.

Larvae. First instar (fig. 11): 1·5-2·0 mm long; head very dark brown with Y-shaped pale or reddish mark; antennae pale yellow with basal segment dark brown; prothorax very dark brown with pale or reddish central line; meso- and metathorax pale with two lateral brown longitudinal lines; legs pale yellow; abdomen pale with some dark markings (as in figure) and the last segment dark brown.

Second instar: 2·5 mm. long; head and thorax entirely dark brown with pale or red central line that bifurcates on head just behind the eyes; antennae light brown, basal segment almost black; legs pale yellow; abdomen light brown with lateral margins pale.

Third instar: 3·0-3·5 mm. long; as second, but paler, pattern intermediate between second and fourth.

Fourth instar (fig. 19): 4·4-4·8 mm. long; much paler than third with central pale area on head and thorax wider; antennae pale with only the base of the first segment dark; abdomen with pale median areas just anterior to openings of dorsal abdominal glands; i.e. on segments 3, 4 and 5; margins widely pale and pale mid-lateral areas are present on segments 4-7.

Fifth instar: 5·2-5·6 mm. long; as fourth, but generally darker; amount of dark colouring varies, especially on the head.

Biology

The adults (usually short-winged) of this common grassland nabid overwinter and lay eggs in the late spring; these hatch, in southern England, from about the second week of June onwards. The first adults of the new generation may be found in early August.

Nabis ericetorum Scholtz.

Butler (1923) describes the last and an early larva.

Egg (fig. 8): 1·35 mm. long; 0·33 mm. broad; elongate, slightly upcurved towards egg cap which is pale whitish-grey and ovate.

Larvae. First instar (fig. 12): 1·5 mm. long; head pale with brown markings on margins of clypeus and vertex; reddish-brown markings behind eyes; antennae pale with basal segment dark; thorax pale with reddish-brown lateral stripes; legs pale; abdomen pale with darker markings (as in figure).

Second instar: 2·2-2·5 mm. long; as first, but with pale areas on head and thorax wider by comparison with the dark areas.

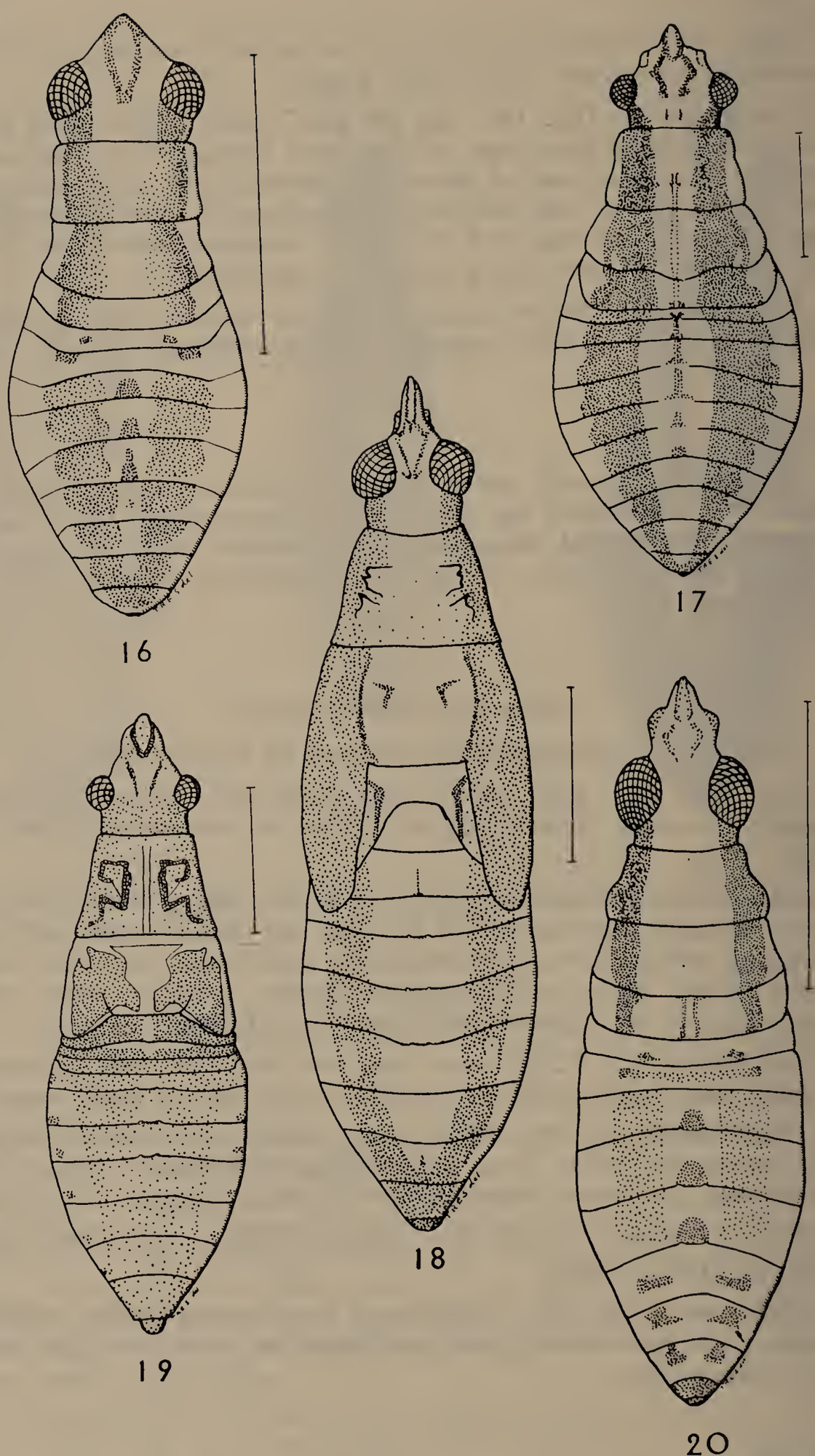
Third instar (fig. 13): 3·0-3·5 mm.; darker than second, dorsum pale yellow-red with three longitudinal red-brown stripes; the central one is more or less confined to the abdomen (see figure).

Fourth instar: 4·0-4·8 mm. long; as third, but dark stripes wider and head darker.

Fifth instar (fig. 14): 5·5-6·0 mm. long; much darker, reddish-brown with few central pale markings (as in figure) and wide pale connexivum.

Biology

This bug is confined to heathlands, otherwise its life-cycle is similar to that of *N. rugosus*. The eggs are laid mainly in grass stems, rarely, if ever, in heather.



Figs. 16-20.—Larvae. 16, *Nabis flavomarginatus* first instar. 17, the same, fourth instar. 18, *N. ferus* fifth instar. 19, *N. rugosus* fourth instar. 20, *Dolichonabis limbatus* first instar. (Scale 1 mm.)

Himacerus mirmicoides Costa

Butler (1923) describes the egg and various instar larvae, he figures the last instar in colour; van Dinther (1953) describes the second, third and fifth instars, figuring the third.

Egg: Butler (1923) considers Chapman's (1906) description refers to this species.

Larvae. First instar (fig. 28): 1·75 mm. long; head and thorax light brown with Y-shaped pale central line and spine-like projections of the meso- and meta-thorax reddish; antennae brown, becoming darker towards the tips; legs light brown becoming paler towards the tips; abdomen brown with first and second segments largely pale (see fig. 28) and a median scale-like projection on posterior margin of first, connexivum of segments 4-8 narrowly pale; sparsely covered with long (about 0·15 mm.) hairs.

Second instar (fig. 1): 3·0 mm. long; as first.

Third instar: 4 mm. long; as second but with posterior angles of prothorax pale and two slight vertical projections on either side of the mid line of the second abdominal segment, each bearing a long hair.

Fourth instar: 5 mm. long; as third, but with last three antennal segments, base of lateral thoracic projections, apices of femora, anterior and mid tibiae, base of hind tibiae and basal parts of second tarsal segment pale.

Fifth instar: 6 mm. long; as fourth, but with tips of wing pads, which are well developed, broadly pale; without lateral thoracic projections; vertical projections on second abdominal segment well marked; outer margin of connexivum of segments 3-8 marked with brown.

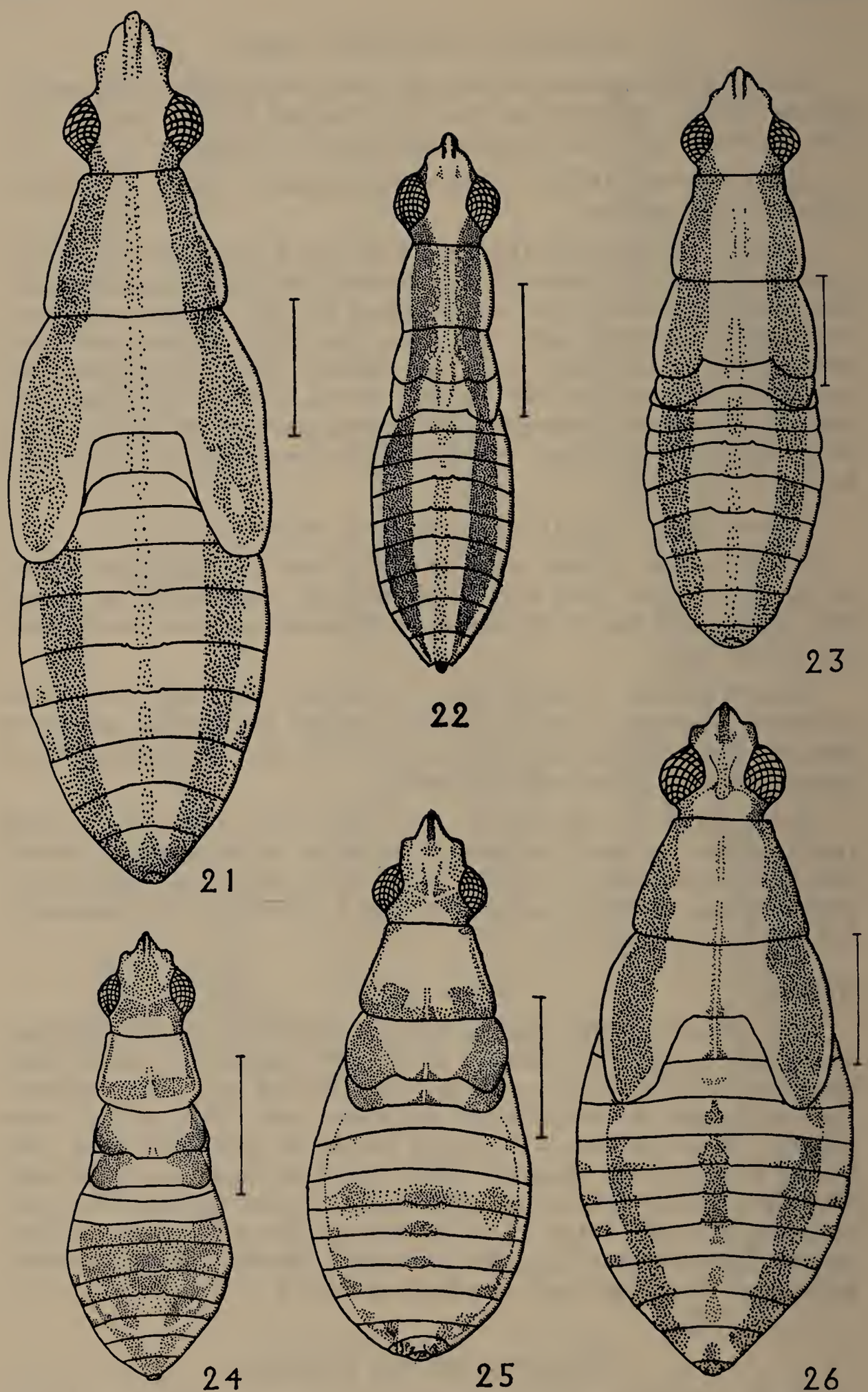
Biology

The larvae of this species have a distinctly ant-like appearance, this is less well-marked in the last instar, by which time they are considerably larger than any British ant. The association with ants is definitely not a close one. The adults overwinter. The eggs are laid over a period in June and July and larvae of all stages may be found together in great abundance. The first adults of the new generation appear in late July, the majority a month later. This is perhaps the most characteristic nabid of gardens and it is also commonly found in nettle patches, hedgerows and clearings, especially on chalk or sand.

Himacerus apterus Fabricius

Butler (1923) describes various instars and van Dinther (1953) "probably the third", the fourth and fifth, he figures the fourth.

Egg: Described by Steer (1929).



Figs. 21-26.—Larvae. 21-23, *Stalia major*. 21, fifth instar. 22, third instar. 23, fourth instar. 24-26, *S. boops*. 24, third instar. 25, fourth instar. 26, fifth instar. (Scale 1 mm.)

Larvae. First instar (fig. 27): 2 mm. long; dark brown with pale or reddish Y-shaped mark on head and central line on thorax; margins of metathorax pale, widely so anteriorly; margins of first and second abdominal segments widely pale; abdomen held in a raised and arched position giving an ant-like appearance.

Second instar: 3 mm. long; head brown with pale Y-shaped mark; antennae light brown, basal segment darker; thorax brown with a thin central line, a wide lateral prothoracic stripe enlarging on to the dorsal surface of the meso- and meta-thorax; legs dark brown with tibiae lighter; first abdominal segment largely pale, but with a somewhat wider dark brown band in a median anterior position; abdominal segments 3-9 dark brown with pale connexivum, spiracular openings brown; venter largely pale with lateral brown markings on the head and thorax and median brown spots on the abdomen; body sparsely covered with long fine single hairs, antennae and legs more thickly clothed; without the ant-like appearance noted in first instar.

Third instar: 3·8-4·0 mm. long; as second.

Fourth instar (fig. 29): 4·5-5·5 mm. long; as third, but legs distinctly banded with pale and dark areas, head, thorax and abdomen with pale areas (as shown in figure).

Fifth instar: 6-7 mm. long: as fourth but with general colour an even darker brown and brown markings on connexivum well marked; pale patches on abdomen somewhat variable, generally much as fourth.

Biology

This is the only really arboreal British nabid; the egg overwinters in the twigs of various trees, hatching in May and June and the last instar larvae are found from July until August. The adults are usually brachypterous, but macropterous specimens sometimes occur especially in the females (Leston, 1951). The biology and feeding habits of this species have been studied by Strawinski (1935).

Stalia major Costa.

Butler (1923) describes ovarian eggs and two (probably the fourth and fifth) larval instars.

Egg (fig. 5): 2 mm. long; 0·5 mm. broad; tubular, slightly upcurved towards egg cap which is pale greyish brown and more or less triangular in surface view.

Larvae. First instar (fig. 9): 2-2·6 mm. long; dorsum black with pale Y-shaped mark on head and thorax; extreme lateral margins of mesothorax and metathorax and abdominal connexivum pale; antennae and legs pale yellow.

Second instar (fig. 15): 3·0-3·5 mm. long; as first with prothorax margins and median areas on abdominal segments pale.

Third instar (fig. 22): 4·0-4·5 mm. long; dark markings brown, rather than black, head with lateral margins broadly brown, clypeus and vertex marked with light brown; thorax with two broad brown lateral stripes becoming much paler towards the mid line and then an abrupt thin dark line adjoining narrow central pale stripe, lateral margins narrowly pale; abdomen with broad brown lateral markings of thorax continued, slightly broken on segments 1 and 2; centre of abdomen with thin brown line, U-shaped on segment 1 and absent from the posterior margin of segments 2 and 3.

Fourth instar (fig. 23): 5·0-5·5 mm. long; pale areas of dorsum now enlarged; prothorax often without or with only very pale lines, central area.

Fifth instar (fig. 21): 6-6·5 mm. long; as fourth, but with brown areas relatively narrower; those on wing pads with wavy inner margins and pale patches.

Biology

Overwintering as an egg in the stems of grasses, often *Dactylis glomerata,* this nabid is common in wastelands. The eggs hatch in early May and the adults are found from late June onwards. It is noteworthy that the earlier larval instars are some of the darkest nabid larvae and the later ones some of the palest. This contrasts with *Nabis flavomarginatus* in which the reverse obtains and we think that this fact misled Butler (1923); his "very young" *Nabis flavomarginatus* larvae, "entirely pitchy black and shining" being referable to this species. This species exhibits marked periodic diel movements up and down the grass stems; during the day it is seldom taken by sweeping but at night it is found quite commonly. Similar behaviour has been observed in *Nabis flavomarginatus* and *Dolichonabis limbatus* and probably occurs in many grass dwellers (Fewkes, 1961).

Stalia boops Schioedte

Gravestein (1955) figures the last larval instar.

Egg (based on ovarian eggs) (fig. 6): 2·3 mm. long; 0·5 mm. broad; the egg cap is quite circular.

Larvae. First and second instars: unknown.

Third instar (fig. 24): 3·5 mm. long; head largely brown with Y-shaped pale reddish mark, lateral areas around base of antennae and posterior pale; antennae pale yellowish; prothorax pale yellow with W-shaped brown mark; mesothorax and metathorax with brown margins and short paired brown central lines; legs pale yellowish with apices of mid and hind femora brown; abdomen pale yellow with variable brown markings on segments 3, 4 and 5 on the lateral margins of segments 6, 7 and 8.

Fourth instar (fig. 25): 4·5 mm. long; much as third but abdomen paler and apices of femora brown.

Fifth instar (fig. 26): 5·5 mm. long; as fourth but darker; three longitudinal dark brown stripes of the adults now clearly visible and connexivum of segments 3-8 marked with dark brown.

Biology

Often considered one of our rarer nabids, *S. boops* is, in our experience, usually to be found if a thorough study is made of any area of rough grassland in Southern England. There is no doubt it is usually present in smaller numbers than *S. major, N. flavomarginatus* and the other nabids that occur with it. However, its scarcity is exaggerated by its habit of always hunting close to the ground, at least during the day and hence the old records from vole-runs (Butler, 1923). The eggs overwinter and the new generation and adults appear from mid July onwards. Normally brachypterous, there are a few records of macropterous specimens.

Dolichonabis limbatus (Dahlbom)

Butler (1923) describes the last and two earlier instars. There are in fact only four larval instars in *D. limbatus* and we have assumed that the same is true for *D. lineatus*. As Butler remarks, the sexes are easily distinguishable in the later larvae (figs. 32 and 33), this is true for most Heteroptera so far as the last instar is concerned, but the degree of distinction in the penultimate is remarkable. The last instar is figured by van Dinther (1953).

Egg (fig. 4): 2·25 mm. long; 0·4 mm. broad; elongated, becoming narrower and slightly curved before operculum, which is flat, brownish and oval.

Larvae. First instar (fig. 20): 2·5 mm. long; head pale with margins of clypeus, bases of antennae, V-shaped mark on vertex and region behind the eyes brown; antennae pale yellowish-brown; thorax with brown lateral stripes and paired thin central brown line more or less marked; legs pale, tarsi darker, abdomen with median and two lateral brown stripes, connexivum broadly pale; degree of development of central stripe variable.

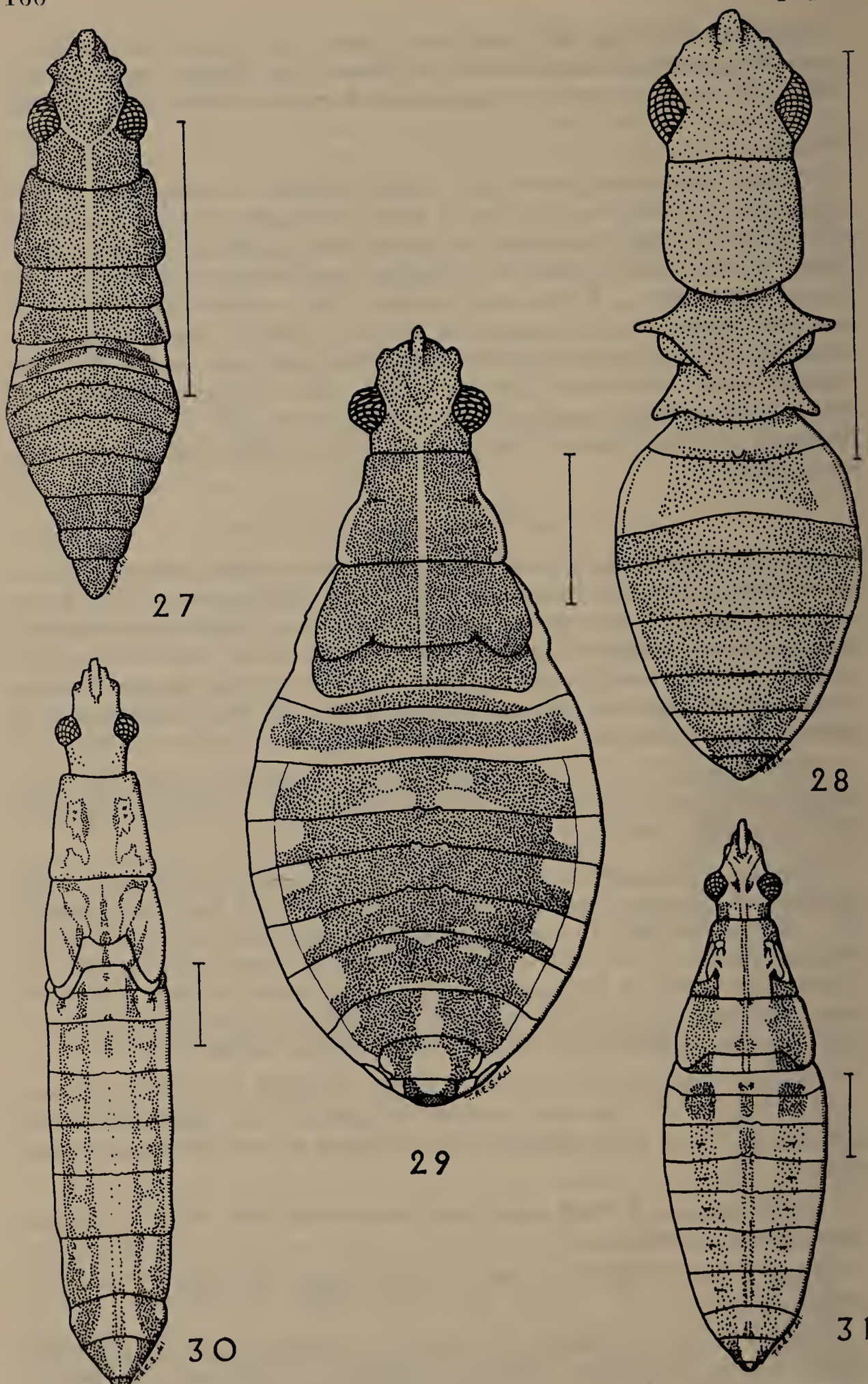
Second instar: 3·0-3·5 mm. long; as first but with lateral brown bands of abdomen less well marked (i.e. pale and more diffuse) and legs with distinct brown spots where the major hairs arise.

Third instar: 4·0-5·0 mm. long; as second but with V-shaped mark on head enlarged.

Fourth instar (fig. 31): 6·0-7·0 mm. long; as third.

Biology

Common in grasslands and rank vegetation, this bug prefers rather damp conditions; *Holcus* is often a constituent of a sward where it is found. The eggs overwinter and hatch towards the end of May. The adults are found from early July onwards and are almost always, in our experience, micropterous.



Figs. 27-31.—Larvae. 27, *Himacerus apterus*, first instar. 28, *H. mirmicoides*, first instar. 29, *H. apterus*, fourth instar. 30, *Dolichonabis lineatus*, fourth instar. 31, *D. limbatus*, fourth instar. (Scale 1 mm.)

Dolichonabis lineatus (Dahlbom)

Butler (1923) describes the last instar.

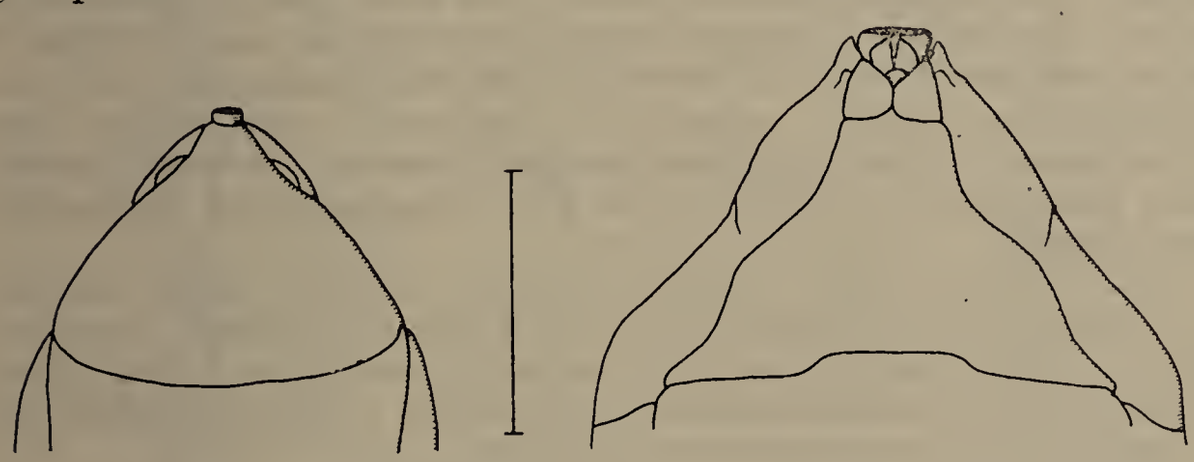
Egg: unknown.

Larvae. First instar: unknown.

Second instar: 5 mm. long; head light brown with margins of clypeus, V-shaped mark on vertex and area behind eyes dark brown; thorax pale with wide brown lateral stripes, much broken (rather as in fig. 30) and dark central line; legs with distinct brown spots where hairs arise; abdomen light brown with a wide connexivum and two pale lines either side of central brown line, with a slight tendency for the lateral brown lines to be paler in the centre. (Only one specimen was available for study and measurement).

Third instar: 6 mm. long; as second.

Fourth instar (fig. 30): 9-10 mm. long; as second but paler and markings of head, thorax and abdomen more broken (as in figure); abdomen often with the lateral stripes completely divided by a pale line.



32 33

Figs. 32-33.—Ventral view of tip of abdomen of fourth instar larvae of *Dolichonabis limbatus*. 32, male. 33, female. (Scale 0·5 mm.)

Biology

This local bug is a marsh insect and is found around the roots of reeds and rushes in marshy situations, and under chenopods on salt marshes. Second and third instar larvae have been found in June and the life-cycle is probably similar to that of *D. limbatus*.

Keys to Eggs

The terms used in the description are those defined by Southwood (1956a), who describes and figures the structure of the egg of *Nabis flavomarginatus* and the egg and hatching spines and ridges of *Dolichonabis limbatus*.

1. Operculum domed, projecting well above the level of the top of rim of the chorion (fig. 3) ..... *N. flavomarginatus.*
   Operculum often concave, always either level with or considerably below the rim of the chorion (fig. 2) ..... 2.
2. Micropylar region long, half as long as wide ..... *Himacerus.*
   Micropylar region shorter, length less than half width ... 3.
3. Operculum tapered towards one end (figs. 4 and 5) ..... 4.
   Operculum more or less circular or oval (figs. 6-8) ..... 5.
4. Operculum strongly tapered (fig. 5) ..... *S. major.*
   Operculum only slightly tapered (fig. 4) ..... *D. limbatus.*
5. Egg over 2 mm. long ..... *S. boops.*
   Egg under 1·6 mm. long ..... 6.
6. Larger, usually just over 1·5 mm. long; operculum oval (fig. 8) ..... *N. ericetorum*
   Smaller, usually under 1·5 mm. long; operculum almost circular (figs. 7) ..... *N. ferus* and *N. rugosus.*

Key to Larvae

The different larval instars may be separated by reference to Southwood (1956b). However, in many Nabidae the meso- and meta-thoracic segments are disproportionate even in the first instar; this disproportion is always less than that in the second instar. In the second instar of many species the hind margin of the mesothorax is curved forwards near the margin (fig. 15). In micropterous nabids, especially *Himacerus mirmicoides,* the development of the wing pads is slightly less in the fourth instar, than that figured by Southwood for a macropterous anthocorid and a mirid.

The larvae of the species described in this paper can be separated by the following key. It must be stressed, however, that in many species there is considerable variation in the colour pattern and all determinations should be checked against the diagnostic measurements given in Table 1.

The figures in brackets after the specific names refer to the instars keying out at that point.

1. Antennae entirely dark brown (genus *Himacerus*) ..... 2.
   Antennae not entirely dark brown ..... 3.
2. Dorsum of first abdominal segment with a median scale-like projection (fig. 1) ..... *H. mirmicoides* (I-V)
   Dorsum of first abdominal segment simple ... *H. apterus* (I-V)
3. Apices of hind femora dark (genus *Stalia,* later instars) ... 4.
   Femora more or less uniformly coloured or, if marked, then marks not confined to apices ..... 5.
4. Half or more than half dorsal surface of head dark (proportion decreasing with instar) (figs. 24-26); ratio of maximum width to total length equal to or less than 1 : 3 (antennae shorter) ..... *S. boops* (III, IV and V).
   Less than half dorsal surface of head dark (proportion decreasing with instar—figs. 21 and 23); ratio of maximum width to total length greater than 1 : 3 (antennae longer) ... *S. major* (IV and V)

Table 1. The diagnostic measurements of the larvae of the common British Nabidae in hundredths of a mm. All values are means (usually of five larvae), the maximum range due to individual variation is of the order of 10% of the mean value.

	First instar					*Second instar*					*Third instar*					*Fourth instar*					*Fifth instar*				
	Head width	Antennal length				Head width	Antennal length				Head width	Antennal length				Head width	Antennal length				Head width	Antennal length			
		1	2	3	4		1	2	3	4		1	2	3	4		1	2	3	4		1	2	3	4
N. flavomarginatus	53	25	32	38	67	64	24	48	54	78	78	49	73	75	87	92	66	105	107	94	106	77	148	136	106
N. ferus	37	20	28	38	55	45	29	40	48	64	54	38	58	73	64	67	51	83	80	69	80	68	110	110	80
N. rugosus	43	21	26	47	70	51	32	53	64	78	62	45	74	86	91	77	63	103	108	97	86	75	130	121	100
N. cricetorum	31	21	23	44	60	46	31	89	63	67	55	99	72	85	76	67	63	99	109	84	82	78	131	124	90
H. mirmicoides	52	20	38	43	62	65	28	53	55	70	75	38	73	75	78	91	50	99	96	88	104	63	128	120	95
H. apterus	55	38	63	80	100	66	43	73	88	105	78	55	85	108	111	91	80	130	145	128	110	107	185	186	140
S. major	53	27	31	36	82	64	33	46	52	91	77	45	62	68	100	89	56	93	97	111	110	63	120	117	108
S. boops			—					—			73	38	52	55	86	84	43	64	71	100	99	51	85	87	110
																	(*Last instar*)								
D. limbatus	50	33	48	62	92	60	49	77	88	104	74	68	114	117	122	91	98	170	158	140					
D. lineatus			—			62	58	95	113	155	75	88	145	147	178	101	105	180	180	207					

5. Head, prothorax almost entirely black or very dark brown and with only Y-shaped pale mark, figs 9, 11 and 15 ..... 6.
Head and prothorax not entirely black or dark brown, sometimes largely pale ..... 7.

6. Antennae entirely pale yellowish ..... *S. major* (I and II)
Antennae light brown with basal segment dark, often almost black ..... *N. rugosus* (I, II and III)

7. Dorsum of thorax with brown or black (entire or broken) lateral markings, which are wider than the central pale stripes (e.g. figs. 22 and 30) ..... 8.
Dorsum of thorax with dark lateral markings each narrower than the central pale stripe (often with two very thin median lines which are neglected for the purposes of the above comparison) (e.g. figs. 16, 18, 20 and 31) ..... 16.

8. Wide lateral stripes on thoracic segments not broken, dark brown or black and shining ..... *S. major* (II and III)
Lateral marking on thoracic segments broken or patterned, brown and matt, not shining ..... 9.

9. 9 mm. or more in length ..... *D. lineatus* (IV)
Under 7 mm. in length ..... 10.

10. Wing pads of mesothorax not entirely covering those of metathorax (3rd and 4th instar) 11
Wing pads of mesothorax completely overlapping those of metathorax (5th instar) 13

11. Length of fourth antennal segment equal or almost equal to total width of head; dark blackish brown (if fourth instar over 4·8 mm. long) ..... *N. flavomarginatus* (III and IV)
Length of fourth antennal segment greater (by almost a quarter) than the head is wide; brown or reddish brown (always fourth instar, under 4·8 mm. long) ..... 12.

12. Fourth antennal segment shorter (0·84 mm.), only a third as long again as first segment ..... *N. ericetorum* (IV)
Fourth antennal segment longer (0·97 mm.), half as long again as basal segment ..... *N. rugosus* (IV)

13. Over 6·0 mm. long; head more than 1 mm· wide; dark blackish brown ..... *N. flavomarginatus* (V)
Under 5·8 mm. long; head less than 0·9 mm. wide; brown or reddish-brown markings ..... 14.

14. Total length of antennae not more than 3·8 mm.
N. ferus (dark forms) (V)
Total length of antennae more than 4·2 mm. ..... 15.

15. Fourth antennal segment about a quarter as long again as first; brown ..... *N. rugosus* (V)
Fourth antennal segment only slightly longer than first; reddish-brown ..... *N. ericetorum* (V)

16. Pale areas reddish yellow ..... *N. ericetorum* (I, II and III)
Pale areas yellow, never with any red colour ..... 17.

17. Whole antenna more than four times as long as head is wide; parallel sided, abdomen not or barely wider than thorax ..... *D. lineatus** (II-III) and *D. limbatus* (I-IV)
    Whole antenna less than four times as long as head is wide; not parallel sided, abdomen often half as wide again as prothorax ..... 18.
18. Wing pads developed on both meso- and meta-thorax (Fourth and fifth instars) ..... *N. ferus* (IV and V)
    wing pads absent or only developed on mesothorax (First to third instar) ..... 19.
19. Larger with darker markings, first instar 1·7-2·0 mm.; second instar 2·8-3·2 mm.; third instar 3·6-3·8 mm. ..... *N. flavomarginatus* (I-III)
    Smaller with light brown markings, first instar 1·5 mm. or less; second instar 2·5 mm.; third instar 3·0-3·5 mm. ..... *N. ferus* (I-III)

*It is probable that the first instars of *D. lineatus* would separate out at this point; the two species can easily be distinguished by the greater length instar for instar of *D. lineatus*.

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